

Amendments to the Specification

IN THE ABSTRACT OF THE DISCLOSURE

Attached hereto is a replacement (or new) Abstract.

IN THE WRITTEN DESCRIPTION

Please replace paragraph [0006] with the following amended paragraph:

[0006] With the solid-phase reaction method, a mixture of starting material powders such as oxalates, carbonates, oxides, and the like is placed in a firing container such as a crucible or the like and heated at a high temperature for a long time to induce a solid-phase reaction, followed by grinding in a ball mill or the like. However, the oxide powder manufactured by this method has an irregular shape and consists of particle aggregates with a large particle size distribution. Moreover, a large amount of impurities are introduced from the crucible or in the grinding process. Further, when double oxides are manufactured, treatment is required to be conducted for a long time at a high temperature in order to improve compositional homogeneity. As a result, the production efficiency is poor. Furthermore, the particle surface was modified and a large number of defects were produced on the particle surface and inside thereof by chemical reactions and physical impacts during grinding. As a result, the crystallinity was decreased and physical properties inherent to oxides were degraded.

Please replace paragraph [0009] with the following amended paragraph:

[0009] With the spray pyrolysis method, a solution obtained by dissolving or dispersing a metal compound in water or an organic solvent is sprayed to obtain fine liquid droplets and the droplets are heated under the conditions allowing a metal oxide to precipitate, thereby producing a metal oxide powder. With such a method, agglomeration-free fine monodisperse

particles can be obtained and the amount of introduced impurities is small. Furthermore, because the starting materials are in the form of a solution, metal components can be mixed homogeneously at any ratio. For those reasons, this method is considered to be suitable for the manufacture of double oxide powders. For example, Japanese Patent Publication No. 2001-152146 described the manufacture of a fine phosphor powder with excellent fluorescence properties by this method.

Please replace paragraph [0011] with the following amended paragraph:

**[0011]** It is an object of the present invention to manufacture an oxide powder having a high crystallinity, a high dispersibility, and a uniform particle size, without introducing impurities therein, by a low-cost and simple production equipment. In particular the present invention provides a manufacturing method suitable for the manufacture of functional oxide powders such as phosphors that are strongly required to have good compositional homogeneity and a high crystallinity, or an oxide powder serving as a starting material for functional ceramics and functional composite materials. It is yet another object to obtain an oxide powder with a high purity, a high dispersibility, a high crystallinity, and a uniform particle size as well as a shape and a particle size suitable for thick-film pastes such as phosphor pastes, inks, paints, and the like.

Please replace paragraph [0030] with the following amended paragraph:

**[0030]** In accordance with the present invention, a powder containing at least one material selected from the group consisting of metals, semimetals, metal compounds, and semimetal compounds is prepared as a starting material powder. Examples of powders of compounds of metals and semimetals include inorganic compound powders or organic compound powders

such as oxides, hydroxides, nitrates, sulfates, oxynitrates, ~~oxysulfates~~ oxysulfates, halides, carbonates, borates, silicates, ammonium salts, ammonium complexes, phosphates, carboxylates, resins, sulfonates, acetylacetonates, alkoxides, amide compounds, imide compounds, urea compounds, and the like. Examples of suitable compounds of semimetal elements such as boron, silicon, phosphorus, and the like include boric acid, phosphoric acid, silicic acid, and the like.

Please replace paragraph [0044] with the following amended paragraph:

**[0044]** As a more preferable embodiment, the starting material powder is ejected into the reaction vessel at a high rate under a condition such that  $V/S > 600$ , where  $V$  (L/min) is a flow rate of the carrier gas per unit time and  $S$  (cm<sup>2</sup>) is a cross-sectional area of the opening of the nozzle. As a result, then the starting material powder can be effectively dispersed in a gas phase by rapid expansion of the gas inside the reaction vessel, without causing re-agglomeration. No specific limitation is placed on the nozzle and nozzles of any shape, for example, nozzles with a round, polygonal, or slit-like cross section, nozzles with a tip of a reduced cross section, and nozzles with a reduced cross section in the medium section and expanding opening, may be used.

Please replace paragraphs [0046] and [0047] with the following amended paragraphs:

**[0046]** In order to conduct heat treatment, while maintaining the dispersed starting material powder at a low concentration, for example, a tubular reaction vessel heated from the outside is used, a starting material powder is ejected together with a carrier gas at a constant flow rate through a nozzle from an opening at one end of the reaction vessel and passed inside the reaction vessel. The oxide powder that is produced by the heat treatment is recovered from the opening at the other end.

The passage time of the mixture of the powder and carrier gas through the reaction vessel is set according to the type of apparatus (or vessel) used so that the powder ~~be~~is heated sufficiently at the prescribed temperature. Usually, this time is about 0.3-30 sec. The heating is conducted from the outside of the reaction vessel, for example, with an electric furnace or a gas furnace, but a combustion flame obtained by supplying a combustion gas into the reaction vessel may be also used.

[0047] The heating is conducted at a temperature higher than the decomposition temperature or reaction temperature of the starting material powder under the conditions producing an oxide powder. The heat treatment should be conducted at a temperature of no less than  $(T_m/2)^\circ\text{C}$ , where  $T_m^\circ\text{C}$  denotes the melting point of the oxide. If the heating temperature is below  $(T_m/2)^\circ\text{C}$ , the target oxide powder cannot be obtained. In order to obtain an oxide powder with an even higher crystallinity, the heating is preferably conducted at a temperature of no less than the sintering initiation temperature of the target oxide.

Please replace paragraphs [0058]-[0060] with the following amended paragraphs:

[0058] According to the analysis of the powder thus obtained with an X ray diffractometer, it was a double oxide powder with extremely good crystallinity that consisted of a single phase represented by  $(\text{Y}_{0.96}\text{Eu}_{0.4})_2\text{O}_3$ . Further, observations conducted with a scanning electron microscope (SEM) showed a powder that consisted of agglomeration-free particles having an almost spherical shape and a narrow particle size distribution with a mean particle diameter of  $1\mu\text{m}$  and with a maximum particle diameter of  $3\mu\text{m}$ . Further, measurements of an emission spectrum at a wavelength of 612 nm under ultraviolet(UV) irradiation at a wavelength of 147 nm showed that the fluorescence intensity was 150% of the fluorescence intensity of the powder with a mean particle diameter of  $3\mu\text{m}$

that was obtained by the conventional solid-phase reaction method.

#### Example 2

**[0059]** A carbonate composite powder with a mean particle diameter of about  $2\mu\text{m}$  that was prepared in the same manner as in Example 1 was mixed with an air carrier gas by—~~a~~ using an ejector-type dispersing machine. The solid-gas mixture thus obtained was ejected through a nozzle with a cross-sectional area of the opening of  $0.13\text{ cm}^2$  at a flow rate of  $200\text{ L/min}$  into a reaction tube heated to a temperature of  $1550^\circ\text{C}$  in an electric furnace, passed through the reaction tube and heated. The feed rate of the powder, the dispersion concentration of the starting material powder in the gas phase in the reaction tube, and V/S were identical to those of Example 1 and were  $5\text{ kg/hr}$ ,  $0.4\text{ g/L}$ , and 1500, respectively.

**[0060]** The powder obtained was confirmed by the X ray diffraction analysis to be a  $(\text{Y}_{0.96}\text{Eu}_{0.4})_2\text{O}_3$  powder with a very high crystallinity. The results of SEM observations demonstrated that the powder obtained consisted of agglomeration-free spherical particles and had a mean particle diameter of  $0.8\text{ }\mu\text{m}$  and a maximum particle diameter of  $2\mu\text{m}$ , that is, had a particle size less and—~~the~~ particle size distribution narrower than the powder of Example 1 that was obtained without using the dispersing machine. The fluorescence intensity at a wavelength of  $612\text{ nm}$  under UV irradiation at a wavelength of  $147\text{ nm}$  was identical to that of Example 1.

Please replace paragraph [0062] with the following amended paragraph:

**[0062]** Further, the fluorescence intensity presented in the table is the fluorescence intensity at a wavelength of  $612\text{ nm}$  under UV irradiation at a wavelength of  $147\text{ nm}$  and is a relative intensity which is referred to the fluorescence intensity of a  $(\text{Y}_{0.96}\text{Eu}_{0.4})_2\text{O}_3$  powder with a mean particle

diameter of 3 $\mu$ m that was obtained by the conventional solid-phase reaction method, the latter fluorescence intensity being taken as 100. The crystallinity is represented by a relative intensity ~~referred~~referring to the X ray diffraction intensity of the powder of Example 1 that was taken as 100.

Please replace paragraph [0075] with the following amended paragraph:

**[0075]** Barium nitrate and iron nitrate nonahydrate were weighed to obtain a molar ratio of 1:12 and dissolved in deionized water to obtain a solution with a total metal ion concentration of about 0.2 mol/L. The solution was heated at a temperature of 80°C, urea was added to give a concentration of urea of 2 mol/L under stirring and a homogeneous precipitation reaction caused by the urea hydrolysis reaction was initiated. Once the pH of the solution reached 8, the reaction system was cooled and the reaction was terminated. The precipitate thus formed was filtered, dried at a temperature of 100°C and then calcined at a temperature of 600°C. Then grinding was conducted in a jet-mill and a starting material powder with a uniform particle size and a mean particle diameter of about 2 $\mu$ m was obtained.

Please replace paragraphs [0079] and [0080] with the following amended paragraphs:

**[0079]** The analysis of the powder obtained with an X ray diffractometer showed the oxide powder with a very high crystallinity and which consisted of ZnO single phase. Observations conducted with a scanning electron microscope (SEM) confirmed a powder which consisted of agglomeration-free particles having an almost spherical shape and a narrow particle size distribution with a maximum particle diameter of 5 $\mu$ m and a mean particle diameter of 2 $\mu$ m.

Examples 15-18

[0080] Oxide powders were manufactured in the same manner as in Example 14, except that the dispersion concentration of the starting material powders in the gas phase, cross-sectional area of the opening of the nozzle, and the temperature of the electric furnace were selected from the temperatures shown in Table 2. Characteristics of the powders obtained are shown in Table 2. The crystallinity is represented by a relative intensity ~~referred~~referring to the X ray diffraction intensity of the powder of Example 14 that was taken as 100.

Please replace paragraph [0089] with the following amended paragraph:

[0089] Commercial basic cobalt carbonate was ground with a jet-mill and a starting material powder with a mean particle diameter of about  $1\mu\text{m}$  was obtained. The powder at a feed rate of 5 kg/hr was mixed with an air carrier by ~~a~~using an ejector-type dispersing machine and the solid-gas mixture thus obtained was ejected through a nozzle with a cross-sectional area of the opening of  $0.13\text{ cm}^2$  at a flow rate of 200 L/min into a reaction tube heated to a temperature of  $1500^\circ\text{C}$  in an electric furnace, passed through the reaction tube, while maintaining the dispersion concentration of the powder, and heated. The melting point of cobalt oxide is about  $1935^\circ\text{C}$ . The dispersion concentration of the starting material powder in the gas phase inside the reaction tube was 0.4 g/L, and V/S was 1500. The dark gray powder thus obtained was collected with a bag filter.

Please replace paragraph [0093] with the following amended paragraph:

[0093] Further, because starting materials are not in the form of a solution or suspension, the energy loss on solvent evaporation is less than that of the usual spray pyrolysis method and manufacturing can be conducted at a low cost. Moreover, the problem of liquid droplets merging with each other is avoided and dispersing in a gas phase can be

conducted to a comparatively high concentration as compared with the spray pyrolysis method, thereby providing for a high efficiency. Moreover, because it is not necessary for the starting materials to be formed ~~to~~into a solution or suspension, the starting materials can be selected from a wide range of materials. Therefore, oxide powders of a variety of types can be manufactured.